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The Impact of Window Configuration on the Overall Building Energy Consumption under Specific Climate Conditions

ZEKRAOUI Djamel[a], ZEMMOURI Noureddine[a].*

[a] Laboratory of design and modeling of architectural forms and ambiences (LACOMOFA)

University Mohamed Kheider Biskra - Algéria

Abstract

The present research investigates the effect of orientation and façades openness and glazing type on global energy consumption in typical offices under the specific climate of present areas in the south of Algeria using Eneryplus software version (8.4.0), a serie of simulations has been performed in order to establish the optimal window configuration in terms of area orientation and glazing type .

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Key words: Energy consumption; sustainable development ; Energy plus; opening ; Ratio (window, wall); Orientation; glazing Type.

1. Introduction

Buildings consume about 40%of the world's energy [1], the use of electric power and heat in the building sector also participate at gaz emissions, sustainability with efficient energy use and minimal environmental impact has become a major building design goal.

Façade openings configuration have a great impact on the overall energy consumption of a building as it represents the most energy sensitive part of building envelope.

The use of large glazing openings in present areas has become an accepted architectural trends in Algeria without any knowledge of their drastic effects on building energy performance.

* Corresponding author. Tel.: +213670313453; fax: +0-000-000-0000 .
E-mail address: djamelzekraoui@gmail.com

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The article analyses different window configuration on space user comfort and energy consumption in office building in Biskra (Algeria) using parametric window design alternatives.

2. Role of windows

The window is considered the weakest thermal link in a building envelope for heat gain in summer and heat loss in winter. Although it presents a small area of the building, it has the greatest effect on heat flow than walls, ceilings, and floors of the building. Therefore, it is considered as one of the important elements that affect the building energy consumption [2].

In general, the thermal performance of a window can be basically specified by three factors, which are the thermal transmittance (U-value), total solar energy transmittance (g-value), and air leakage (L). These factors describe all amounts of heat flow through a window [3].

Windows are also responsible for about 25-30% of the heat loss in a building because window glazing is a poor insulator [4]. Besides shading devices there are three parameters that determine the amount of heat gain and heat loss through windows, which are the window to wall area ratio (WWR), the window orientation, and the thermal properties of glass material [5]. This research focuses on these parameters to design windows according to heating and cooling requirements in winter and summer, under the specific climate conditions of desert area.

3. Building energy modeling

In the first decades of the twenty-first century , the wide availability of powerful scaled computers with sufficient strong and graphic capabilities have enabled of transition in the fundamental means of building representation from two dimensional drawings as diagrams of design to three dimensional, behaviorally dynamic digital prototypes.

Among the tools available to architects, designers, and engineers in the study of energy-related behaviors, energy simulation software is the most efficient. Through creating a virtual building environment, these software packages provide for the expert the opportunity to predict the actual performance of the building as well as optimize and improve its design and make use of new energy-efficient technologies for it [6].

Building energy modeling (BEM) is a representation of energy performance within a building user simulation.

Since simulation isolates a small range or one building feature for evaluation, it allows design analysis to objectively identify the right building element of energy- saving measure from analysis of the result isolating an energy –saving feature prioritizes a specific design objective.

In the present case openings orientation of a basic office on the site during conceptual design will determine which energy –saving measure is most critical.